

# Ventilation Air Energy Recovery for Laboratories

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# Overview

- Ventilation requirements and energy use
- Energy recovery technologies
- Design considerations and key issues
- Codes and standards
- Energy performance
- Resources



# Lab Ventilation Requirements

- 100% outside air
- 6-15 ACH versus less than 1 ACH of outside air in an office
- 5-10 times the energy use of an office building

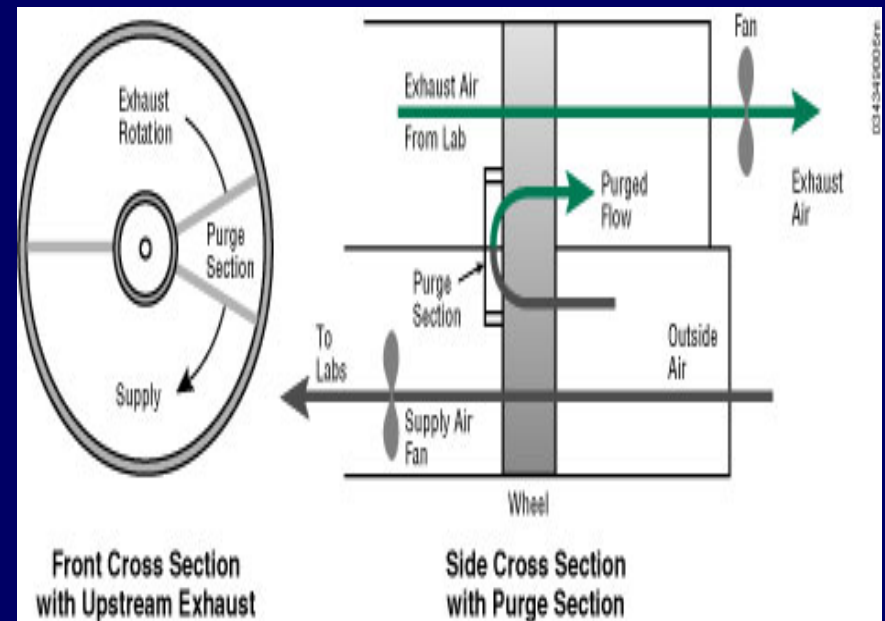


# ERV Performance Characteristics

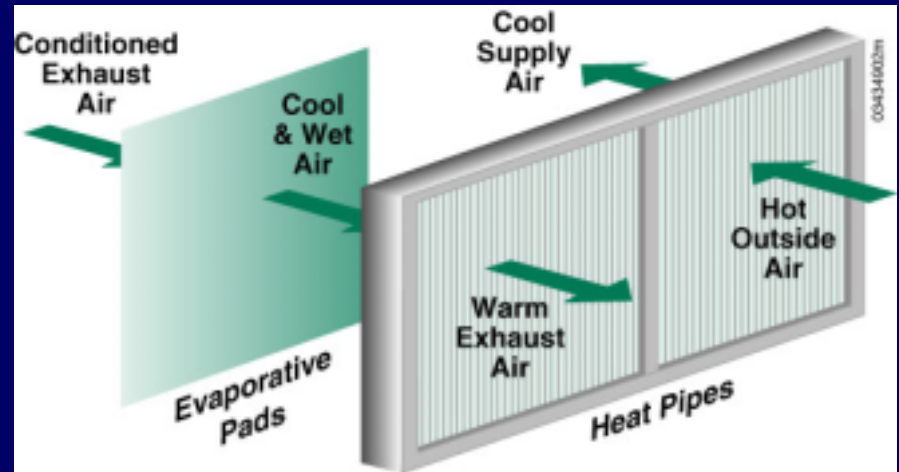
- Effectiveness: Sensible, Latent, Total
  - ratio of actual energy recovered to theoretically possible
- Pressure drop
  - 1" w.g. or less
- Face velocity
  - 500 fps or less

# Enthalpy Wheels

- Supply and exhaust air streams located next to each other
- ~75% effectiveness
- Reduce potential cross-contamination: choice of desiccant and purge
- Part-load operation: wheel speed or bypass



# Heat Pipes



- ❑ Sensible only
- ❑ Adjacent supply and exhaust air streams, unless modified heat pipe used
- ❑ 45%-65% effectiveness
- ❑ Cross contamination not an issue
- ❑ Part-load operation: bypass or tilting
- ❑ Relatively low maintenance



# Fox Chase Cancer Center

- 2 – 30,000 cfm air-handling units
- Heat pipes with bypass sections and indirect evaporative cooling on exhaust
- \$300,000 first cost
- \$72,510 annual energy cost savings

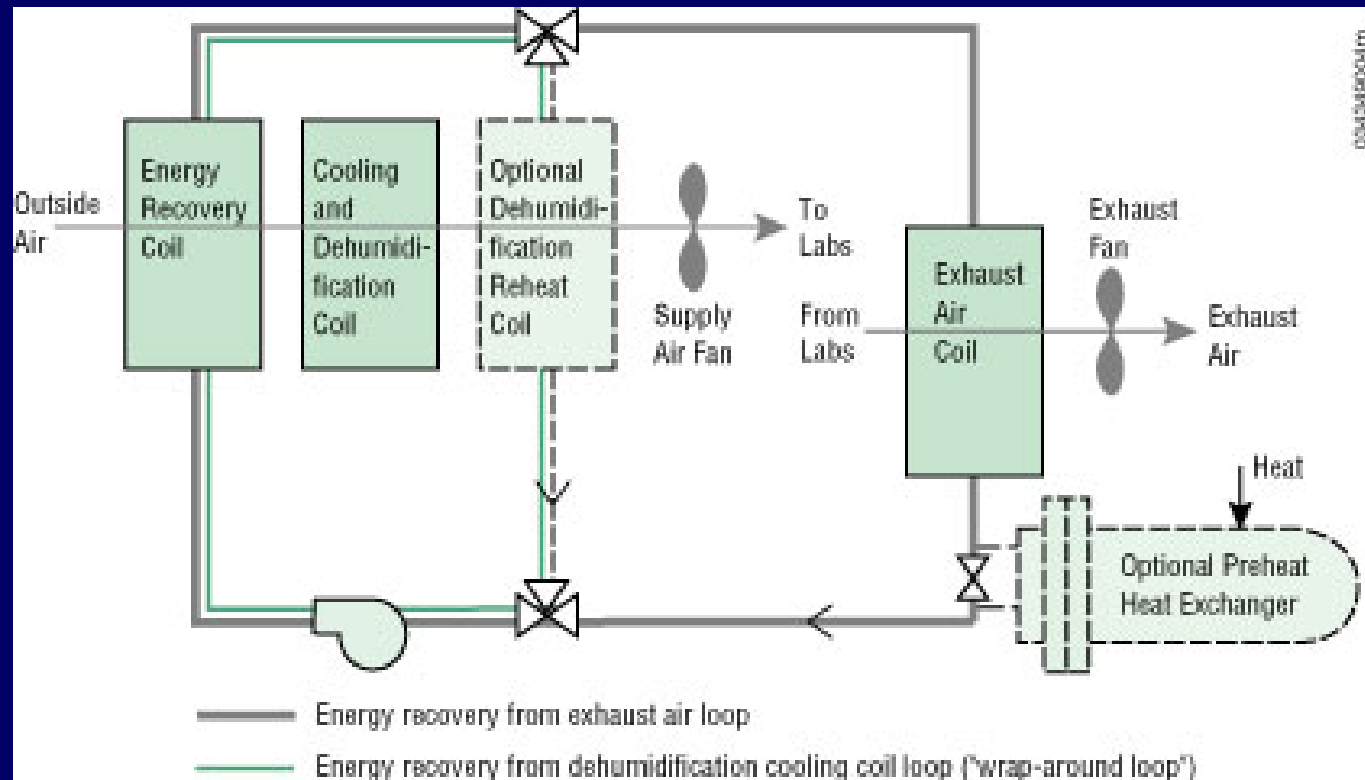


# Run-around Loops

- ❑ Air streams do not need to be next to one another
- ❑ 55%-65% effectiveness
- ❑ No cross-contamination issues
- ❑ Familiar components



# Run-around Loop Example





# Design Considerations

- Identify opportunities
  - Manifold exhaust systems
- Location of supply and exhaust
- Consider options for dehumidification
- Assess risk
- Address potential for fouling and corrosion



# Design Considerations

- ❑ Control strategies for part-load operation, avoid condensation and freezing
- ❑ Space requirements
- ❑ O&M costs
- ❑ Energy cost savings
- ❑ First cost impact
- ❑ Commissioning



# Codes and Standards

- ❑ ARI 1060-2000 for Air-to-Air Energy Recovery Ventilation Equipment
- ❑ ANSI 84-1991, Method of Testing Air-to-Air Heat Exchangers
- ❑ International Mechanical Code, section 514 (2003)
- ❑ NFPA 45 (2001)
- ❑ ASHRAE 90.1-2001



# Energy Simulations Analysis

- DOE-2.2
- 100,000 sf building
- Minneapolis, Denver, Seattle, and Atlanta

[www.labs21.lbl.gov/docs/labs21anal\\_3410.pdf](http://www.labs21.lbl.gov/docs/labs21anal_3410.pdf)



# Energy Savings

- Annual energy savings range from \$0.25/cfm to \$2.0/cfm of supply air flow
- Reduces gas usage for space heating by more than 35%
- Peak electricity savings of 3 W/sf with enthalpy wheels in humid climates
- Increase in annual fan energy use offset cooling electricity savings
- Downsize equipment



# Resources

- ASHRAE HVAC Systems Handbook
- ASHRAE Laboratory Design Guide
- LBNL: A Design Guide to Energy-Efficient Research Laboratories
- ARI Certified Product Directory:  
[www.ari.org](http://www.ari.org)